[10191/1264A]

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s)	:	Kurt BURGER et al.
Serial No.	:	To Be Assigned
Filed	:	Herewith
For	:	METHOD AND DEVICE FOR VACUUM-COATING A SUBSTRATE
Examiner	:	To Be Assigned
Art Unit	:	To Be Assigned

Assistant Commissioner
for Patents
Washington, D.C. 20231

PRELIMINARY AMENDMENT AND

37 C.F.R. § 1.125 SUBSTITUTE SPECIFICATION STATEMENT

SIR:

Please amend the above-identified application before examination, as set forth below.

IN THE SPECIFICATION AND ABSTRACT:

In accordance with 37 C.F.R. § 1.121(b)(3), a Substitute Specification (including the Abstract, but without claims) accompanies this response. It is respectfully requested that the Substitute Specification (including Abstract) be entered to replace the Specification of record.

IN THE CLAIMS:

On page 27, delete line 1, and insert:
--What Is Claimed Is:--.

Please cancel, without prejudice, original claims 1-35 of the underlying PCT application. Please also cancel, without prejudice, substitute claims 1, 10, and 20.

Please add the following new claims:

36. (New) A method for vacuum-coating a substrate using a plasma CVD, comprising the steps of:

applying a substrate voltage to the substrate during a coating of the substrate in order to control ion bombardment, the substrate voltage being a direct voltage pulsed in a bipolar fashion, positive pulses and negative pulses of the substrate voltage being independently adjustable of one another according to at least one of a chronological length and a chronological height;

producing the substrate voltage and a coating plasma independently of one another; and

modifying the substrate voltage during the coating of the substrate.

37. (New) The method according to claim 36, wherein the substrate voltage has a frequency of 0.1 kHz to 10 MHz.

38. (New) The method according to claim 36, wherein the substrate voltage has a frequency of 1 kHz to 100 kHz.

39. (New) The method according to claim 37, further comprising the step of:

superimposing a direct voltage on the substrate voltage.

40. (New) The method according to claim 37, wherein the substrate voltage has voltage-free pause times between the positive pulses and the negative pulses of the substrate voltage, the voltage-free pause times ranging from 0 msec to 1 msec.

41. (New) The method according to claim 41, wherein the voltage-free pause times range from 2 µsec to 100 µsec.

42. (New) The method according to claim 40, wherein one of

the voltage-free pause times after a negative pulse is shorter than one of the voltage-free pause times after a positive pulse.

43. (New) The method according to claim 36, further comprising the step of:

adding gases of different types and in various combinations during the coating.

44. (New) The method according to claim 42, further comprising the step of:

performing one of the steps of conducting added gases through a plasma source and introducing the added gases near the plasma source.

45. (New) The method according to claim 42, further comprising the step of:

using as a reactive gas one of:

C_XH_Y,

silanes and siloxanes,

noble gases,

metallo-organic compounds, and

a combination of at least two of C_XH_Y, silanes and siloxanes, noble gases, and metallo-organic compounds.

46. (New) The method according to claim 45, wherein C_XH_Y includes C_2H_2 and CH_4.

47. (New) The method according to claim 45, wherein silanes and siloxanes include one of SiH_4 and HMDS and derivates.

48. (New) A device for vacuum-coating a substrate, comprising:

a vacuum recipient;

a bearing device for reception of the substrate;

a first arrangement for producing a plasma in an interior of the vacuum recipient; and

a voltage supply device for producing a substrate voltage applied to the substrate, the voltage supply device being separately controllable from the first arrangement, the voltage supply device being a direct-voltage power supply pulsed in a bipolar fashion, at least one of lengths and heights of positive pulses of the substrate voltage and negative pulses of the substrate voltage being separately adjustable from one another.

49. (New) The device according to claim 48, wherein the first arrangement includes a microwave source, a sputter cathode, a hollow cathode, and one of a high-frequency source and a second arrangement for producing a high-current arc.

50. (New) The device according to claim 48, wherein the voltage supply device includes a bias power supply unit pulsed in a bipolar fashion.

51. (New) The device according to claim 48, wherein the device is operated as a pass-through arrangement, the substrate being one of unmoved, moved in a uniform fashion, and moved in pulsed fashion.

52. (New) The device according to claim 48, wherein the first arrangement is operated in a pulsed fashion.

53. (New) A method for vacuum-coating a substrate using a plasma CVD, comprising the steps of:

applying a substrate voltage to the substrate during a coating of the substrate in order to control ion bombardment, the substrate voltage being a direct voltage

pulsed in a bipolar fashion, positive pulses and negative pulses of the substrate voltage being independently adjustable of one another according to at least one of a chronological length and a chronological height;

producing the substrate voltage and a coating plasma independently of one another;

modifying the substrate voltage during the coating of the substrate; and

manufacturing a carbon layer using a device including:

a vacuum recipient,

a bearing device for reception of the substrate,

an arrangement for producing a plasma in an interior of the vacuum recipient, and

a voltage supply device for producing the substrate voltage applied to the substrate, the voltage supply device being separately controllable from the arrangement.

54. (New) The method according to claim 53, wherein the carbon layer is an amorphous carbon layer.

55. (New) A method for vacuum-coating a substrate using a plasma CVD coating, comprising the steps of:

applying a substrate voltage to the substrate during a coating of the substrate in order to control ion bombardment, the substrate voltage being a direct voltage pulsed in a bipolar fashion, positive pulses and negative pulses of the substrate voltage being independently adjustable of one another according to at least one of a chronological length and a chronological height;

producing the substrate voltage and a coating plasma independently of one another;

modifying the substrate voltage during the coating

of the substrate; and

manufacturing a silicon layer using a device including:

a vacuum recipient,

a bearing device for reception of the substrate,

an arrangement for producing a plasma in an interior of the vacuum recipient, and

a voltage supply device for producing the substrate voltage applied to the substrate, the voltage supply device being separately controllable from the arrangement.

56. (New) The method according to claim 55, wherein the silicon layer is an amorphous silicon layer.

57. (New) A method for vacuum-coating a substrate using a plasma CVD coating, comprising the steps of:

applying a substrate voltage to the substrate during a coating of the substrate in order to control ion bombardment, the substrate voltage being a direct voltage pulsed in a bipolar fashion, positive pulses and negative pulses of the substrate voltage being independently adjustable of one another according to at least one of a chronological length and a chronological height;

producing the substrate voltage and a coating plasma independently of one another;

modifying the substrate voltage during the coating of the substrate; and

manufacturing a multilayer coating structure using a device, the multilayer coating structure including a layer containing metal for imparting adhesion and an amorphous carbon layer applied on the layer containing metal, transitions to the layer containing metal corresponding to gradients over at least one-fifth of a

thickness of at least one of the layer containing metal and the amorphous carbon layer, the device including:

a vacuum recipient,

a bearing device for reception of the substrate,

an arrangement for producing a plasma in an interior of the vacuum recipient, and

a voltage supply device for producing the substrate voltage applied to the substrate, the voltage supply device being separately controllable from the arrangement.

58. (New) A method for vacuum-coating a substrate using a plasma CVD coating, comprising the steps of:

applying a substrate voltage to the substrate during a coating of the substrate in order to control ion bombardment, the substrate voltage being a direct voltage pulsed in a bipolar fashion, positive pulses and negative pulses of the substrate voltage being independently adjustable of one another according to at least one of a chronological length and a chronological height;

producing the substrate voltage and a coating plasma independently of one another;

modifying the substrate voltage during the coating of the substrate; and

depositing a layer system containing one of silicon, boron, nitrogen, oxygen, carbon, a metal, and a combination of at least two of silicon, boron, nitrogen, oxygen, and a metal by using a device including:

a vacuum recipient,

a bearing device for reception of the substrate,

an arrangement for producing a plasma in an interior of the vacuum recipient, and

a voltage supply device for producing the

substrate voltage applied to the substrate, the voltage supply device being separately controllable from the arrangement.

59. (New) A method for vacuum-coating a substrate using a plasma CVD, comprising the steps of:

applying a substrate voltage to the substrate during a coating of the substrate in order to control ion bombardment, the substrate voltage being a direct voltage pulsed in a bipolar fashion, positive pulses and negative pulses of the substrate voltage being independently adjustable of one another according to at least one of a chronological length and a chronological height;

producing the substrate voltage and a coating plasma independently of one another;

modifying the substrate voltage during the coating of the substrate; and

manufacturing a multilayer structure of alternating individual layers using a device including:

a vacuum recipient,

a bearing device for reception of the substrate,

an arrangement for producing a plasma in an interior of the vacuum recipient, and

a voltage supply device for producing the substrate voltage applied to the substrate, the voltage supply device being separately controllable from the arrangement.

60. (New) A multilayer structure, comprising:

hard material individual layers; and

one of carbon individual layers and silicon individual layers, the hard material individual layers alternating with the one of the carbon individual layers and the silicon individual layers, the multilayer

structure being manufactured by:

applying a substrate voltage to the substrate during a coating of the substrate in order to control ion bombardment, the substrate voltage being a direct voltage pulsed in a bipolar fashion, positive pulses and negative pulses of the substrate voltage being independently adjustable of one another according to at least one of a chronological length and a chronological height,

producing the substrate voltage and a coating plasma independently of one another, and

modifying the substrate voltage during the coating of the substrate.

61. (New) The multilayer structure according to claim 60, wherein the carbon individual layers include one of:

amorphous carbon containing hydrogen,

amorphous hydrogen-free carbon,

carbon containing silicon, the carbon containing silicon including one of carbon containing hydrogen and hydrogen-free carbon, and

carbon containing metal, the carbon containing metal including one of carbon containing hydrogen and hydrogen-free carbon, the metal being selected from a group including hard secondary group metals.

62. (New) The multilayer structure according to claim 60, wherein the silicon individual layers include one of:

an amorphous silicon contain hydrogen,

an amorphous hydrogen-free silicon,

a silicon containing carbon, the silicon containing carbon including one of carbon containing hydrogen and hydrogen-free carbon, and

a silicon containing metal, the silicon containing metal including one of silicon containing hydrogen and

hydrogen-free silicon.

63. (New) The multilayer structure according to claim 60, wherein the hard material individual layers include one of a metal, a metal compound, carbon containing metal carbide, silicon containing metal, and a mixture of at least two of a metal, a metal compound, carbon containing metal carbide, and silicon.

64. (New) The multilayer structure according to claim 63, wherein the metal is one of tungsten, chromium, titanium, niobium, and molybdenum.

65. (New) The multilayer structure according to claim 63, wherein the metal compound includes a metal carbide, a metal nitride, a metal silicide, a metal corbonitride, a metal carbosilicide, and a metal sliconitride.

66. (New) The multilayer structure according to claim 60, wherein the individual layers of the multilayer structure include one of:

at least one type of the hard material individual layers; and

at least one type of one of the carbon individual layers and the silicon individual layers.

67. (New) The multilayer structure according to claim 66, further comprising:

one type of the hard material individual layers; and

one type of the one of carbon individual layers and the silicon individual layers.

68. (New) The multilayer structure according to claim 60, wherein a thickness of at least one of the hard material individual layers and the one of the carbon individual layers

and the silicon individual layers is between approximately 1 nm and approximately 10 nm.

69. (New) The multilayer structure according to claim 68, wherein a thickness of at least one of the hard material individual layers and the one of the carbon individual layers and the silicon individual layers is approximately 2 nm and approximately 5 nm.

70. (New) The multilayer structure according to claim 60, wherein an overall thickness of the multilayer structure is between approximately 1 µm and approximately 10 µm.

71. (New) The multilayer structure according to claim 70, wherein the overall thickness is between approximately 1 µm and approximately 4 µm.

72. (New) The multilayer structure according to claim 60 wherein:

the hard material individual layers include one of a metal, a metal carbide, a metal nitride, a metal silicide, a metal carbosilicide, and a metal siliconitride, and

the carbon individual layers include one of a carbon containing hydrogen and an amorphous hydrogen-free carbon.

73. (New) The multilayer structure according to claim 63, wherein:

the hard material individual layers are C-(WC) layers, and

the carbon individual layers are carbon containing hydrogen layers.

74. (New) The multilayer structure according to claim 63,

wherein:

the hard material individual layers are metal carbide layers, and

the carbon individual layers are metal carbide layers.

75. (New) The multilayer structure according to claim 63, wherein:

the hard material individual layers include one of a metal, a metal carbide, a metal nitride, a metal silicide, a metal carbosilicide, and a metal siliconitride, and

the silicon individual layers include one of a silicon containing hydrogen and an amorphous hydrogen-free silicon.

76. (New) The multilayer structure according to claim 60, wherein a combination of the hard material individual layers and the one of the carbon individual layers and the silicon individual layers includes at least one of silicon, boron, nitrogen, oxygen, carbon and a metal, and wherein boron and carbon not being simultaneously present in the individual layers.

77. (New) The multilayer structure according to claim 60, wherein one of a machining tool and a non-cutting shaping tool is coated with the multilayer structure.

Remarks

This Preliminary Amendment cancels, without prejudice, original claims 1-35 in the underlying PCT Application No. PCT/DE98/01610. This Preliminary Amendment also cancels, without prejudice, substitute claims 1, 10, and 20, and adds new claims 36-77. The new claims conform the

claims to U.S. Patent and Trademark Office rules and do not add new matter to the application.

The above amendments to the specification and abstract conform the specification and abstract to U.S. Patent and Trademark Office rules, and do not introduce new matter into the application.

The underlying PCT Application No. PCT/DE98/01610 includes an International Search Report, dated November 20, 1998. The Search Report includes a list of documents that were uncovered in the underlying PCT Application. A copy of the Search Report is included herewith.

The underlying PCT Application No. PCT/DE98/01610 also includes a Preliminary Examination Report, dated October 13, 1999. An English translation of the Preliminary Examination Report is submitted herewith.

It is respectfully submitted that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

Respectfully submitted,

Dated: 12/21/01

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Applicant(s)	:	Kurt BURGER et al.
Serial No.	:	To Be Assigned
For	:	METHOD AND DEVICE FOR VACUUM-COATING A SUBSTRATE
Examiner	:	To Be Assigned
Group Art Unit	:	To Be Assigned

Assistant Commissioner
for Patents
Washington, D.C. 20231

SUPPLEMENTAL PRELIMINARY AMENDMENT

SIR:

As a supplement to the Preliminary Amendment filed herewith, please further amend the above-identified application before examination, as set forth below.

IN THE CLAIMS:

In addition to the previously canceled original claims 1-35, please also cancel claims 36-77, without prejudice in the newly submitted English translation, and please add the following new claims:

78. (New) A plasma CVD device for vacuum coating a substrate, comprising:

a vacuum recipient;

a bearing device for receiving the substrate to be coated;

an arrangement for producing a plasma in an interior of the vacuum recipient and including one of a microwave source, a sputter cathode, a system for producing a high-current arc, and a hollow cathode; and

a device, capable of being controlled separately from the arrangement for producing the plasma, for producing a substrate voltage that is applied to the substrate to be coated, wherein the device for producing the substrate voltage includes a direct voltage power supply unit that can be pulsed in bipolar fashion so that at least one of a length and a height of a positive pulse and a negative pulse of the substrate voltage

can be adjusted independently of one another.

79. (New) The plasma CVD device according to claim 78, wherein:

the plasma CVD device is operated as a pass-through arrangement in which the substrate is moved on one of a uniform fashion and a pulsed fashion.

80. (New) The plasma CVD device according to claim 78, wherein:

the arrangement for producing the plasma is operated in a pulsed fashion.

81. (New) A multilayer structure, comprising:

alternating individual hard-material layers and one of individual carbon layers and individual silicon layers, wherein:

the hard-material layers include one of a metal, a metal carbide, a metal silicide, a metal carbosilicide, a metal siliconitride, a metal carbide-containing carbon, a metal silicide-containing silicon, and a mixture of at least two of the metal, the metal carbide, the metal silicide, the metal carbosilicide, the metal siliconitride, the metal carbide-containing carbon, and the metal silicide-containing silicon, and

the metal includes one of tungsten, chromium, niobium, and molybdenum.

82. (New) The multilayer structure according to claim 81, wherein:

the carbon layers include one of amorphous carbon containing hydrogen, amorphous hydrogen-free carbon, carbon containing silicon, and carbon containing the metal, and

the metal is selected from hard subgroup metals.

83. (New) The multilayer structure according to claim 81, wherein:

the silicon layers include one of amorphous silicon containing hydrogen, amorphous hydrogen-free silicon, silicon containing carbon, and silicon containing metal.

84. (New) The multilayer structure according to claim 81, wherein:

the hard material layers include at least one type of hard material layer,

the carbon layers include at least one type of carbon layer, and

the silicon layers include at least one type of silicon layer.

85. (New) The multilayer structure according to claim 84, wherein:

the hard material layers include one type of hard material layer,

the carbon layers include one type of carbon layer, and

the silicon layers include one type of silicon layer.

86. (New) The multilayer structure according to claim 81, wherein:

thicknesses of the hard material layers, the silicon layers, and the carbon layers are between approximately 1nm and approximately 10 nm.

87. (New) The multilayer structure according to claim 81, wherein:

thicknesses of the hard material layers, the silicon layers, and the carbon layers are between approximately 2 nm and approximately 5 nm.

88. (New) The multilayer structure according to claim 81, wherein:

an overall layer thickness of the multilayer structure is between approximately 1 μm and approximately 10 μm.

89. (New) The multilayer structure according to claim 81, wherein:

an overall layer thickness of the multilayer structure is between approximately 1 μm and approximately 4 μm.

90. (New) The multilayer structure according to claim 81, wherein:

the hard material layers include one of Me, MeC, MeSi, Me(CSi), and Me(SiN),

and

the carbon layers include one of a-C:H and a-C.

91. (New) The multilayer structure according to claim 81, wherein:

the multilayer structure is made up of alternating C-(WC) layers and a-C:H layers.

92. (New) The multilayer structure according to claim 81, wherein:

the multilayer structure is made up of alternating MeC layers and C-(MeC) layers.

93. (New) The multilayer structure according to claim 81, wherein:

the hard material layers include one of Me, MeC, MeN, MeSi, Me(CN), Me(CSi), and Me(SiN), and

the silicon layers include one of a-Si:H or a-Si.

94. (New) The multilayer structure according to claim 81, wherein:

one of the hard material layers, the carbon layers, and the silicon layers contain at least one of silicon, boron, nitrogen, oxygen, carbon, and a metal, and

boron and carbon are not simultaneously present in the one of the hard material layers, the carbon layers, and the silicon layers.

95. (New) The multilayer structure according to claim 81, wherein:

the multilayer structure is capable of coating one of a machining tool and a non-cutting shaping tool.

Remarks

This Preliminary Amendment cancels claims 36-37, without prejudice, in the replacement English translation of the underlying PCT Application No. PCT/DE98/01610, and adds new claims 76-95. The new claims do not add new matter to the application but do conform the claims to U.S. Patent and Trademark Office rules.

Applicants assert that the present invention is new, non-obvious, and useful. Consideration and allowance of the claims are requested.

Respectfully submitted,

KENYON & KENYON

Dated: 12/21/01

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